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(54) **ULTRASONICALLY ACTIVATED CONTINUOUS SLITTER APPARATUS AND METHOD**

ULTRASCHALLAKTIVIERTE KONTINUIERLICH ARBEITENDE SPALTVORRICHTUNG SOWIE VERFAHREN

DECOUPEUSE EN CONTINU COMMANDEE PAR ULTRASONS ET PROCEDE CORRESPONDANT

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Description

[0001] The present invention relates generally to the confectionery processing, and more particularly, to the slitting of extended, continuous lengths of confectionery stock.

[0002] Various apparatus and methods have been proposed for cutting food products. Examples are described in European Patent Specification Nos: 0 733 409 and 0 813 937, and British Specification No: 672 688. The present invention is directed at methods and apparatus of this general kind, applied to confectionery products.

[0003] In one of its more preferred forms, the invention is applied to a method and apparatus for longitudinally slitting a continuously moving slab of a composite confectionery product such as, for example, a composite slab having layers of nougat and caramel superimposed to form a wide slab. The slab is formed by successively depositing a mass of a first confectionery product component, such as nougat, from a chill roll onto a conveyor, advancing the first confectionery product component formation thus created toward a station adjacent a second chill roll, at which a top layer of a second confectionery product component, such as caramel, is added to form the composite slab. The conveyor continues to advance the slab toward a cutting station at which a properly arranged, suitably adjusted array of ultrasonically energized slitters continuously slit the slab to provide a continuously moving array of spaced apart strips of confectionery product. These strips are subsequently formed into individual confectionery product segments by transverse cutting (ultrasonic or otherwise) and/or molding (ultrasonic or otherwise).

[0004] Depending on the intentions of the producer and the intended destination of the product, the cut individual shapes can be enrobed with a coating of chocolate. Thereafter, the individual finished products may be wrapped and boxed for sale and shipment.

[0005] An important aspect of the present invention is the design, construction and arrangement of a slitting tool of a desired configuration. Another aspect of the process relates to the manner of positioning the cutting edges of the slitting tool in arrays and the method of advancing the slabs so as to continuously slit the slab into a plurality of product strips.

[0006] Recently, it has been discovered that ultrasonically energized forming tools may be utilized to cut individual pieces of confectionery stock by transverse motion, wherein the stock is compressed between a support surface and a descending knife. In addition, ultrasonically energized product forming tools having a cavity shaped in accordance with the configuration of the product to be formed therewith have been found to be effective in simultaneously cutting and shaping an individual piece of confectionery stock from a leading edge of a strip of stock. This again involves compression and reforming of a piece of stock which is substantially captured or surrounded by the active surfaces of the tool.

[0007] The concept of slitting a continuous slab into plural strips, however, has presented problems and difficulties which, heretofore, have not been overcome by prior art slitters which commonly are in the form of rotary blades. For example, use of these rotary blade slitters have resulted in the build-up of product (particularly with soft and tacky confectionery products such as nougat and caramel layered slabs) which has necessitated frequent shutdown and washing, resulting in costly downtime. Efforts to solve this product build-up have involved the use of scrapers which require otherwise unnecessary personnel to monitor and remove the scraped product. Other efforts to solve this product build-up have involved the application of lubricants to the rotary blades which impart an undesirable slickness to the product that interferes which further processing such as chocolate enrobing and can produce a product of relatively short shelf life. Also, the performance of rotary blade slitters is particularly sensitive to product formulations and conditions, variations therein from narrow parameters can cause product jams, Additionally, rotary blade slitters can cause crunching of inclusions such as nuts and the like, leaving voids in the slab which, among other things, also interferes with chocolate enrobing. As a consequence, these prior art rotary blade slitters systems used in the production of confectionery products have created excessive scrap, produced reduced product yields, and also suffered from related cleanliness or sanitation problems.

[0008] The present invention seeks to overcome these shortcomings by providing a high quality, effective cutting action having a number of significant advantages and beneficial characteristics, including reliability, low cost operation and high production speeds.

[0009] The method of the invention, of forming individual strips of confectionery product from a generally planar and continuous slab of such product, comprises continuously advancing the slab along a path toward a slitting tool at a slitting station, contacting the slab with the slitting tool to form at least one strip from the slab; and advancing the formed strip along said path past the slitting for further processing. According to the invention, the slitting tool has at least a pair of cutting edges oriented at an angle of 40° to 60° with respect to the path of movement of the slab, and node and anti-node portions, which cutting edges are spaced apart a given distance equal to the width of the strip to be formed, the tool being energised to cause its cutting edges to vibrate in the axial direction of the tool at an ultrasonic frequency with the amplitude of vibration over each cutting edge being substantially uniform, and placed in contact with the slab to form at least one strip of confectionery product therefrom.

[0010] Apparatus of the invention comprises a slitting station and an input conveyor for supplying a continuous slab of confectionery stock to the slitting station. According to the invention, the slitting station has a slitter tool comprising an ultrasonic stack including an energy converter for hanging electrical energy into ultrasonic vibration, a booster for increasing the amplitude of said vibra-

tion, and an ultrasonic horn having at least a pair of parallel cutting edges spaced apart a given distance equal to the width of a strip to be formed, the cutting edges being oriented at an angle of 40° to 60° with respect to the path of movement of the slab, and positioned to contact a slab of confectionery material as it passes through the slitting station. The ultrasonic stack is oriented to vibrate the cutting edges in the axial direction of the slitter tool.

[0011] The present invention can be used to rapidly slit a slab of confectionery material into a plurality of adjacent strips of a desired width utilizing ultrasonically energized slitting knives which do not suffer from excessive product build-up characteristic of prior art rotary blade slitters. The invention can also minimize the crunching and fragmentation of inclusions such as nuts and the like and produce product strips which are essentially free of voids.

[0012] A wide variation in product formulations can be accommodated by the present invention, enabling the slitting of a slab of confectionery stock to be efficiently accomplished with highly viscous and/or tacky ingredients such as are associated with lower calorie confectionery products. Apparatus and methods of the present invention are robust in that they can provide grater flexibility in processing parameters and product formulations and conditions than are available with conventional rotary blade slitters.

[0013] Embodiments of the invention will now be described by way of example and with reference to the accompanying drawings wherein like reference numerals indicate corresponding parts throughout, and in which:

Fig. 1 is a perspective view with portions broken away, showing certain important elements of a preferred form of apparatus of a present invention for slitting a continuous length of confectionery feedstock;

Fig. 2 is a side elevational view with portions broken away of the apparatus of Fig. 1;

Fig. 3 is a front view, partly diagrammatic in nature, showing an ultrasonically energized slitter tool used in the apparatus of Figs. 1 and 2;

Fig. 4 is a side elevational view of the tool shown in Fig. 3;

Fig. 5 is a fragmentary front view of an array of ultrasonically energized slitter tool blades used in the apparatus of Figs. 1 and 2;

Fig. 5A is an enlargement of a portion of Fig. 5 illustrating in cross-section the slitter feed belts and underlying support surface of the embodiment of Figs. 1-5;

Fig. 6 is a perspective view of an ultrasonically energized slitter horn used in the apparatus and method of the present invention;

Fig. 7 is a front view of the slitter horn shown in Fig. 6;

Fig. 8 is a perspective view of another embodiment of an ultrasonically energized slitter horn used in the apparatus and method of the present invention;

Fig. 9 is a front view of the slitter horn shown in Fig. 8;

Fig. 10 is a perspective view of another embodiment of an ultrasonically energized slitter horn used in the apparatus and method of the present invention;

Fig. 11 is a front view of the slitter horn shown in Fig. 10;

Fig. 12 is a perspective view of another embodiment of an ultrasonically energized slitter horn used in the apparatus and method of the present invention;

Fig. 13 is a front view of the slitter horn shown in Fig. 12;

Fig. 14 is a fragmentary diagrammatic side view illustrating a portion of an ultrasonically energized slitter tool in operation slitting a slab of confectionery stock in accordance with the present invention;

Fig. 14A is an enlargement of a portion of Fig. 14 illustrating in greater detail the operation of the slitter tool of that embodiment;

Fig. 15 is a fragmentary diagrammatic side view illustrating a portion of an ultrasonically energized slitter tool in operation slitting a slab of confectionery stock in accordance with another embodiment of the present invention;

Fig. 16 is a fragmentary diagrammatic side view illustrating a portion of an ultrasonically energized slitter tool in operation slitting a slab of confectionery stock in accordance with a further embodiment of the present invention.

Fig. 17 is a fragmentary perspective view illustrating a strip separation device used in the present invention;

Fig. 18 is a fragmentary perspective view of one embodiment of slitter feed belt for supplying a slab of confectionery feed stock to an ultrasonically energized slitter tool in accordance with the present invention; and;

Fig. 19 is a fragmentary perspective view of another embodiment of slitter feed belt for supplying a slab of confectionery feed stock to an ultrasonically energized slitter tool in the apparatus of Figs. 1-5.

[0014] The apparatus of the present invention is capable of being embodied in a number of forms, and the inventive process includes several methods all falling within the general ambit of the inventive concept.

[0015] Accordingly, by way of example only and not by way of limitation, a description will be given of several different forms of apparatus, each capable of practicing the invention and each having individual components capable of being varied in constructional details and arrangements. Illustrative methods, the steps of which may also be modified or altered somewhat in use, are also described herein.

[0016] Referring to the drawings, Figs. 1-5 show the invention embodied in a confectionery product slitting apparatus generally designated by the reference numeral 30 which includes a lower support frame portion 31, an

upper frame portion 32 and an array of ultrasonic stacks or drive assemblies 33a-33d which, in the illustrated embodiment, are of identical construction. As best shown in Figs. 3 and 4, each stack or drive assembly comprises a power-supply (not shown) that furnishes electrical energy through a radio frequency cable to a converter 34a wherein high frequency (typically 20 kHz) electrical energy is transduced into vibratory mechanical motion, preferably by a plurality of piezoelectric transducer devices. The output of the converter 34a is amplified, in a booster assembly 35a, and the output end face of the booster 35a is secured by suitable means such as a bolt to the upper surface of ultrasonic horn 36a. Preferably, in this assembly, the components are configured and arranged so that an anti-node or near-maximum mechanical vibration amplitude is provided at the cutting edge 38a of the blade 37a. Amplitudes of vibration may vary depending on the power and the tool design, however, with frequencies from about 20 kHz to about 40 kHz, the amplitudes of the cutting edges that have been useful will range generally from about 10 to about 50 microns. It is possible, however, that vibration amplitudes greater than these could be useful in the practice of the present invention.

[0017] In this illustrated embodiment blades 37a are secured to the horn 36a by a suitable means such as, for example, brazing or electron beam welding. Preferably, at the lower portion of each blade is tapered and the corners 39a and 40a rounded to eliminate fracturing or cracking during operation.

[0018] As best shown in Figs. 1 and 2, lower support frame portion 31 has a plurality of elastomeric slitter infeed belts 42 which overlie a support surface 43 having a plurality of longitudinal channels 43a. As best shown in Fig. 5A, channels 43a are separated by ridges 43b that serve as anvils for cutting edges 38a of blades 37a. The elastomeric slitter infeed belts 42 are suitably guided and driven by a plurality of pulleys 44, 45, 46 and 47 in a known manner. In this regard, it will be appreciated that while elastomeric slitter infeed belts 42 are, in the illustrated embodiment, shown as a plurality of separate belts spaced apart a distance sufficient to receive therebetween the cutting edge portions of the ultrasonically vibrating blades 37, the plurality of individual belts can be replaced by a continuous single belt.

[0019] A continuous moving slab of confectionery product is supplied to the slitting apparatus 30 in a known manner. This slab can be in the form of a single layer or a composite slab formed by successively depositing a mass of confectionery material such as nougat from a chill roll (not shown) onto a conveyor (not shown) and advancing that deposited material toward a station wherein a second confectionery material such as caramel is supplied from another chill roll to form a composite slab. The slab is then passed through a cooling tunnel (not shown) and conveyed therefrom to a hold down roller 48 which is supported by a pair of brackets 49 and 51 in a known manner. In the illustrated embodiment, the slab of confectionery material is supplied to the location of the hold down roller 48 by a conveyor of any suitable type such as, for example, a steel belt conveyor which deposits the slab onto a transfer plate 52. A steel belt conveyor affords the advantage of providing cooling at the bottom of the slab thereby facilitating release of the composite slab onto the transfer plate 52.

[0020] In accordance with an important aspect of the present invention, the cutting edges of the blades 37 are selectively positionable so that they collectively provide a common cutting angle and spacing with respect to the slab of confectionery material being supplied thereto. This can, at least in part, be accompanied by mounting the individual ultrasonic stacks 33a-33d on a carrier plate 56 that is selectively adjustable for height and angle. Additionally and/or alternatively, provisions can be made for separately adjusting the elevation and/or angle of each of the individual stacks. Regulation of these adjustments can be provided by known servo systems such as, for example, linear or rotary servos which can be electrically, hydraulically or pneumatically controlled.

[0021] If desired, the array of individual ultrasonic stacks 33a-33d can be adjusted for height and angle as illustratively shown in Fig. 2. As shown, the ultrasonic stacks are supported on the carrier plate 56 which, in turn, is operatively mounted to a rack and pinion adjustment system that includes an upper geared rack 53, a lower geared rack 54 and a pinion gear 55. The carrier plate 56 which is, in turn, fixed to a pivotally mounted stack positioning plate 57 secured to the inside surface of left side plate 32a of upper frame portion 32 and a like stack positioning plate on the inside surface of right side plate 32b of upper frame portion 32. As shown, stack positioning plate 57 includes a pair of pins 58a and 59a and the stack positioning plate (not shown) which is secured to the inside surface of right side plate 32b includes like pins 58b and 59b which are respectively received in arcuate slots 61 and 63 in side plates 32a and 32b. The ultrasonic stack positioning plate 57 as shown in Fig. 1, is pivotally fixed to upper frame support plate 32 by a pivot pin 60. Correspondingly, the ultrasonic stack positioning plate mounted to the inside surface of upper frame support plate 32b is pivotally mounted thereto by means of a pivot pin 62.

[0022] Horizontal adjustment of the entire assembly is provided by a pair of gears 64 and 66 which ride on a geared rack 65 as shown in Fig. 2. In particular, when gear 66 is in the position illustrated in Fig. 2, the assembly is locked. As shown, gear 64 is mounted on an adjustment shaft 67. Accordingly, when gear 66 is rotated into a position wherein it overlies gear 64, the assembly can be moved by rotating adjustment shaft 67 which, in turn, moves the assembly forward or back along the rack 65 as desired.

[0023] Figs. 6-13 illustrate ultrasonic slitter horns of various constructions and configurations which can be used in the practice of the present invention. Referring to Figs. 6 and 7, a composite slitting tool 70 which includes a half wave, low gain slitting horn which is adapted

to be ultrasonically vibrated at a specific frequency depending on the dimensions of the horn which typically could be in the range of from about 20 kHz to about 40 kHz. As shown, the composite horn includes an ultrasonic horn portion 71 and a plurality of symmetrically V-shaped double edged blades 72 which are secured to the horn portion by any suitable means such as, for example, brazing or electron beam welding. Correspondingly, composite horn 73 shown in Figs. 8 and 9 is a half wave, high gain slitter horn which includes a horn portion 74 and a plurality of double edge V-shaped blades 76 secured to the horn portion in a similar fashion and is likewise adapted to be ultrasonically vibrated. In both of these embodiments, the blades are non-resonating, that is they vibrate in an axial direction by reason of the fact that they are attached to the face of the vibrating horn and there is no nodal point along the blades themselves. Since the embodiment shown in Figs. 6 and 7 is a so-called low gain horn, the blades thereof are vibrated at a lower amplitude than that achieved with the embodiment of Figs. 8 and 9 which is a so-called high gain horn which causes the blades to be vibrated at a higher output amplitude.

[0024] Figs. 10-13 illustrate two additional embodiments of slitter horns useful in the practice of the present invention. Both of these embodiments are, in the illustrated embodiment, depicted as being of integral or unitary construction. It will be appreciated, however, that the blades thereof can be separately formed and secured to the body of the mother horn in a composite fashion by suitable means such as brazing or electron beam welding. Both of these embodiments can be characterized as full wave, high gain horns with the embodiment of Figs. 10 and 11 being particularly suited for vibrating at a specific ultrasonic frequency of approximately 40 kHz and the embodiment of Figs. 12 and 13 being particularly suitable for operating it at a specific ultrasonic frequency of approximately 20 kHz. In both of these embodiments, the cutting edges of the blades preferably are at the anti-nodal portion of slitter horn at which near maximum axial vibration is achieved.

[0025] Referring to Figs. 10 and 11, the slitter horn 77 includes a main body portion 78 and a plurality of blades 79 integrally formed therewith. Correspondingly, the embodiment of Figs. 12 and 13 illustrate a slitter horn 81 having a main body portion 82 and a plurality of blades 83. As will be noted, the blades 79 of the embodiment of Figs. 10 and 11 and the blades 83 of Figs. 12 and 13 have respective cutting edges which are similar in configuration to the cutting edge 38a shown in Fig. 4. As was the case with that embodiment, the lower portion of each of the blades 79 and 83 is tapered and the respective corners thereof are rounded to eliminate fracturing or cracking during operation. Also, as will be appreciated, since the cutting edges of the blades of the Figs. 10-13 embodiments are straight (i.e. not V-shaped) they vibrate at uniform amplitude of vibration along their entire working surfaces.

[0026] While the slitter horn/blade assemblies of all of these embodiments can be composed of any suitable metal, it is preferable that they be formed of titanium alloys. The mechanical properties of these alloys and their compatibility with food products combined with their desirable acoustic properties render them highly suitable for use in the present invention. If desired, the blades themselves can be provided with a ceramic coating, a ceramic/Teflon coating, a titanium nitride coating or other suitable coating to enhance their operation.

[0027] In accordance with an important aspect of the present invention, slitter horns of Figs. 6-9 are mounted so that they are generally perpendicular to the plane of the slab of confectionery material supplied thereto while the blades of the slitter horns of Figs. 10-13 are preferably oriented with respect to the horizontal plane of the slab of confectionery material so that the longitudinal axis of each such blade is at an acute angle of from 40° to 60° with angles of approximately 45° being particularly preferred. Variations from and within these ranges can be made depending upon the thickness, composition and physical properties of the slab of confectionery material.

[0028] Referring to Figs. 14 and 14A, reference numeral 85 illustrates one form of slitter/slab contacting arrangement which is suitable in the practice of the present invention. As shown, this arrangement includes a pulley 86 and flexible steel conveyor belt 87 on which a composite slab of confectionery material 88 is carried for contact with the cutting edge 38a of ultrasonically vibrating blade 37a. As best shown in Fig. 14A, the cutting edge 38a and its corner 40a are positioned so that they are in air gap 87 so that they penetrate the full thickness of slab 88 but are not in contact with the top surface of belt 87.

[0029] The slit product discharged on the downstream side of blade 38a comes in contact with a combination doctor blade-strip separation device 90 for peeling off and discharge of adjacent strips 88a and 88b onto alternate up ramps 90a and horizontal ramps 90b, respectively. The thus formed slits 88a and 88b are then respectively transported for further processing by conveyor belts 91 and 92. As shown, conveyor belt 94 is driven around an inner pulley 93 and conveyor belt 92 around an outer pulley 94. Pulleys 93 and 94 co-rotate with each other and are powered by a suitable drive system which is not shown but the construction of which will be apparent to those skilled in this art.

[0030] An alternate embodiment of slitter/slab contacting arrangement is designated in Fig. 15 by the reference numeral 96. In this arrangement, a slitter infeed belt 97 is composed of a suitable flexible elastomeric material. As best shown in Figs. 18 and 19, the profile of belt 97 preferably is embossed to ensure adequate grip with the composite slab 88 to feed to same through and past the cutting edge 38a of ultrasonically vibrating slitter blade 37a without the slab and slitted strips buckling or flaring. Belt 97 is driven around a pulley 98 which, if desired, can be powered in a known manner. If desired, a so-called dead plate 97a can be located on the underside of belt

97 adjacent to pulley 98 directly below cutting edge 38a of blade 37a. As more fully shown in Fig. 17, adjacent strips of confectionery products are discharged onto a strip separation device 100 which includes alternate inclined and horizontal ramps 101 and 102 for direct discharge onto conveyors 91 and 92 and further processing of the thus-formed strips to provide a desired confectionery product.

[0031] A further embodiment of slitter/slab contacting arrangement is depicted by the reference number 103 which includes an infeed conveyor 97 and rotary anvil 99. As shown, the composite slab 88 of confectionery product is discharged directly into the cutting edge 38a of slitter blade 37a and the strips formed thereby are then discharged onto separation device 100 for further processing as noted above. The portions of the surface of rotary anvil 99 which comes in contact with the corners of the blades 37a are composed of a suitable material to avoid damage to the blade while the remaining portions of that surface can be suitably textured to maintain adequate grip with the bottom of the slab.

[0032] The separation device designated by the reference numeral 100 of Figs. 15 and 16, shown in greater detail in Fig. 17, includes a plurality of horizontal ramps 101 which are spaced between inclined ramps 102 so that alternate strips of slit confectionery product will be discharged onto conveyors 91 and 92. In this manner, the dimensional spacing between the adjacent strips is increased immediately after the formation thereof in the slitting station thereby preventing their being re-adhered to each other during further processing.

[0033] Figs. 18 and 19 respectively illustrate two embodiments of elastomeric embossed slitter infeed belt upper layers 97b and 97c which can be utilized for the belt 97 of the Figs. 15 and 16 slitter systems. As shown, the embodiment of Fig. 18 is designated by the reference numeral 106 and includes a generally planar base surface 107 and a plurality of uniformly spaced generally rectangular projections 108 upwardly extending therefrom. Correspondingly, the embodiment of Fig. 19 is designated by the reference numeral 109 and includes a generally planar base surface 110 and a plurality of staggered generally circular upwardly extending projections 111. The height of projections 108 and 111 are such as to raise the slab a sufficient height from the base surfaces 107 and 110, respectively, to permit full penetration of the slab by the cutting edges of the blades without scoring or otherwise damaging the belt.

[0034] As shown in the Fig. 18 embodiment, the elastomeric belt 97b is carried on a flexible support base having a grooved or geared bottom surface 113 for cooperation with a timing gear 114. In the Fig. 19 embodiment, the elastomeric belt 97c is carried on a flexible support base 115 having a V-shaped rib which is adapted to be received in the channels 43a of support surface 43 (Figs. 5 and 5A).

[0035] It will thus be seen that the present invention provides several methods and apparatus for slitting slabs of confectionery products and that representative embodiments of this invention have been described by way of example. It will be appreciated that variations to these described forms of apparatus and method will occur to those skilled in the art and that such variations and changes may be made to the method and apparatus features of this invention without departing from this invention or the scope of the appended claims.

Claims

1. A method of forming individual strips of confectionery product from a generally planar and continuous slab (88) of such product, comprising continuously advancing the slab along a path toward a slitting tool (33) at a slitting station (30); contacting the slab with the slitting tool to form at least one strip (88a) from the slab; and advancing the formed strip along said path past the slitting station for further processing,
CHARACTERIZED IN THAT
the slitting tool has at least a pair of cutting edges (38a) oriented at an angle of 40° to 60° with respect to the path of movement of the slab, and node and anti-node portions, which cutting edges are spaced apart a given distance equal to the width of the strip to be formed, the tool being energised to cause its cutting edges to vibrate in the axial direction of the tool at an ultrasonic frequency with the amplitude of vibration over each cutting edge being substantially uniform, and placed in contact with the slab to form at least one strip of confectionery product therefrom.

2. A method according to Claim 1 wherein the tool is ultrasonically vibrated at a frequency of at least 10 kHz.

3. A method according to Claim 2 wherein the tool (30) is ultrasonically vibrated at a frequency in the range 20 kHz to 40 kHz.

4. A method according to any preceding Claim wherein the amplitude of vibration of the cutting edges (38a) of the tool is in the range 10 to 50 microns.

5. The method of Claim 4 wherein the amplitudes of vibration of the cutting edges (38a) of the tool is in the range 28 to 35 microns.

6. A method according to any preceding Claim wherein the slitting tool (30) includes at least three cutting edges (38a) which form at least a pair of adjacent strips (88a) of confectionery product, and wherein the method includes the step of increasing the dimensional spacing between such adjacent strips (88a) immediately after their formation.

7. A method according to any preceding Claim wherein

the slitting tool (30) includes a horn (77,81) having integrally formed blades (79,83) with cutting edges formed thereon.

8. A method according to Claim 7 wherein the cutting edges of the blades (76) are at said anti-node portion of the tool.

9. A method according to any of Claims 1 to 6 wherein the slitting tool includes a horn (70,73) having separately formed blades (72,76) fixed to the horn with cutting edges formed thereon.

10. A method according to Claim 9 wherein the blades (72,76) are non-resonant and vibrate in response to the ultrasonic vibration of the horn (70,73) when the tool is energized.

11. Apparatus for slitting a slab (88) of confectionary material, comprising a slitting station (30); and an input conveyor (42,43) for supplying a slab of confectionery stock to the slitting station,
CHARACTERIZED IN THAT
the slitting station has a slitter tool comprising an ultrasonic stack including, an energy converter (34a) for changing electrical energy into ultrasonic vibration, a booster (35a) for increasing the amplitude of said vibration, and an ultrasonic horn (70,73,77,81) having at least a pair of parallel cutting edges (38a) spaced apart a given distance equal to the width of a strip (88a) to be formed, the cutting edges being oriented at an angle of 40° to 60° with respect to the path of movement of the slab (88), and positioned to contact a slab (88) of confectionery material as it passes through the slitting station (30), the ultrasonic stack being oriented to vibrate the cutting edges in the axial direction of the slitter tool.

12. Apparatus according to Claim 11 wherein the horn (77,81) and at least a pair of the parallel cutting edges are integrally formed.

13. Apparatus according to Claim 11 wherein at least a pair of the cutting edges are formed on separate blades which are fixed to the horn (70,73).

14. Apparatus according to any of Claims 11 to 13 wherein the input conveyor comprises a plurality of separate conveyor strips (42) spaced at a distance sufficient to permit the cutting edges (38a) to be received therebetween.

15. Apparatus according to any of Claims 11 to 14 wherein the slitting tool (33) includes at least three cutting edges which are spaced and positioned to form at least a pair of adjacent strips (88a) of confectionery material, the apparatus including means for increasing the dimensional spacing between adjacent strips (88a) immediately after their formation.

16. Apparatus according to any of Claims 11 to 15 wherein a plurality of cutting edges (38a) are included in each of a plurality of ganged ultrasonic stacks (33).

17. Apparatus according to Claim 16 wherein each cutting edge (38a) is formed on a slitter blade oriented at an angle of 45° with respect to the plane of the input conveyor (42,43).

Patentansprüche

1. Verfahren zum Formen von einzelnen Streifen eines Süßwarenerzeugnisses aus einer im Allgemeinen ebenen und durchgehenden Platte (88) eines solchen Erzeugnisses, wobei das Verfahren das durchgehende Vorschieben der Platte längs einer Bahn zu einem Längstrennwerkzeug (33) an einer Längstrennstation (30) hin, das In-Berührung-Bringen der Platte mit dem Längstrennwerkzeug, um wenigstens einen Streifen (88a) von der Platte zu formen, und das Vorschieben des geformten Streifens längs der Bahn an der Längstrennstation vorbei zur weiteren Verarbeitung umfasst,
dadurch gekennzeichnet, dass
das Längstrennwerkzeug wenigstens ein Paar von Schneidkanten (38a), die mit einem Winkel von 40° bis 60° in Bezug auf die Bewegungsbahn der Platte ausgerichtet sind, und Knoten- und Gegenknotenabschnitte hat, wobei die Schneidkanten mit einem gegebenen Abstand entfernt voneinander angeordnet sind, welcher der Breite des zu formenden Streifens gleich ist, dem Werkzeug Energie zugeführt wird, um zu bewirken, dass seine Schneidkanten in der Axialrichtung des Werkzeugs mit einer Ultraschallfrequenz vibrieren, wobei die Amplitude der Vibration über jede Schneidkante im Wesentlichen gleichförmig ist, und in Berührung mit der Platte gebracht werden, um wenigstens einen Streifen des Süßwarenerzeugnisses aus derselben zu formen.

2. Verfahren nach Anspruch 1, wobei das Werkzeug mit einer Frequenz von wenigstens 10 kHz ultraschallvibriert wird.

3. Verfahren nach Anspruch 2, wobei das Werkzeug (30) mit einer Frequenz im Bereich von 20 kHz bis 40 kHz ultraschallvibriert wird.

4. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Amplitude der Vibration der Schneidkanten (38a) des Werkzeugs im Bereich von 10 bis 50 Mikrometer liegt.

5. Verfahren nach Anspruch 4, wobei die Amplitude der

Vibration der Schneidkanten (38a) des Werkzeugs im Bereich von 28 bis 35 Mikrometer liegt.

6. Verfahren nach einem der vorhergehenden Ansprüche, wobei das Längstrennwerkzeug (30) wenigstens drei Schneidkanten (38a) einschließt, die wenigstens ein Paar von benachbarten Streifen (88a) eines Süßwarenerzeugnisses formen, und wobei das Verfahren den Schritt einschließt, den Maßabstand zwischen solchen benachbarten Streifen (88a) unmittelbar nach ihrer Formung zu steigern.

7. Verfahren nach einem der vorhergehenden Ansprüche, wobei das Längstrennwerkzeug (30) ein Horn (77, 81) einschließt, das integral geformte Klingen (79, 83) mit an denselben geformten Schneidkanten hat.

8. Verfahren nach Anspruch 7, wobei sich die Schneidkanten der Klingen (76) an dem Gegenknotenabschnitt des Werkzeugs befinden.

9. Verfahren nach einem der Ansprüche 1 bis 6, wobei das Längstrennwerkzeug ein Horn (70, 73) einschließt, das gesondert geformte Klingen (72, 76), die an dem Horn befestigt sind, mit an denselben geformten Schneidkanten hat.

10. Verfahren nach Anspruch 9, wobei die Klingen (72, 76) nicht-resonant sind und als Reaktion auf die Ultraschallvibration des Horns (70, 73) vibrieren, wenn dem Werkzeug Energie zugeführt wird.

11. Vorrichtung zum Längstrennen einer Platte (88) eines Süßwarenwerkstoffs, die eine Längstrennstation (30) und einen Eingabeförderer (42, 43) zum Zuführen einer Platte eines Süßwarenrohmaterials zu der Längstrennstation umfasst,
dadurch gekennzeichnet, dass
die Längstrennstation ein Längstrennwerkzeug hat, das ein Ultraschall-Schwinggebilde umfasst, das einen Energiewandler (34a) zum Umwandeln von Elektroenergie in Ultraschallvibration, einen Verstärker (35a) zum Steigern der Amplitude der Vibration und ein Ultraschallhorn (70, 73, 77, 81), das wenigstens ein Paar von parallelen Schneidkanten (38a) hat, die mit einem gegebenen Abstand entfernt voneinander angeordnet sind, welcher der Breite eines zu formenden Streifens (88a) gleich ist, einschließt, wobei die Schneidkanten mit einem Winkel von 40° bis 60° in Bezug auf die Bewegungsbahn der Platte (88) ausgerichtet sind und dafür angeordnet sind, eine Platte (88) eines Süßwarenwerkstoffs zu berühren, wenn sie durch die Längstrennstation (30) hindurchgeht, wobei das Ultraschall-Schwinggebilde so ausgerichtet ist, dass es die Schneidkanten in der Axialrichtung des Längstrennwerkzeugs vibrieren lässt.

12. Vorrichtung nach Anspruch 11, wobei das Horn (77, 81) und wenigstens ein Paar der parallelen Schneidkanten integral geformt sind.

13. Vorrichtung nach Anspruch 11, wobei wenigstens ein Paar der parallelen Schneidkanten an gesonderten Klingen geformt ist, die an dem Horn (70, 73) befestigt sind.

14. Vorrichtung nach einem der Ansprüche 11 bis 13, wobei der Eingabeförderer mehrere gesonderte Förderbänder (42) umfasst, die mit einem ausreichenden Abstand angeordnet sind, um zu ermöglichen, dass die Schneidkanten (38a) zwischen denselben aufgenommen werden.

15. Vorrichtung nach einem der Ansprüche 11 bis 14, wobei das Längstrennwerkzeug (33) wenigstens drei Schneidkanten einschließt, die mit Zwischenraum und dafür angeordnet sind, wenigstens ein Paar von benachbarten Streifen (88a) eines Süßwarenwerkstoffs zu formen, wobei die Vorrichtung Mittel einschließt, um den Maßabstand zwischen benachbarten Streifen (88a) unmittelbar nach ihrer Formung zu steigern.

16. Vorrichtung nach einem der Ansprüche 11 bis 15, wobei mehrere Schneidkanten (38a) in jedem von mehreren zu Gleichlauf verbundenen Ultraschall-Schwinggebilden (33) eingeschlossen sind.

17. Vorrichtung nach Anspruch 16, wobei jede Schneidkante (38a) an einer Längstrennklinge geformt ist, die mit einem Winkel von 45° in Bezug auf die Ebene des Eingabeförderers (42, 43) ausgerichtet ist.

Revendications

1. Procédé de formation de bandes individuelles d'un produit de confiserie à partir d'une plaque généralement plane et continue (88) d'un tel produit, comprenant les étapes d'avance continue de la plaque le long d'une trajectoire vers un outil de découpage (33) au niveau d'une station de découpage (30) ; de mise en contact de la plaque avec l'outil de découpage pour former au moins une bande (88a) à partir de la plaque ; et d'avance de la bande formée le long de ladite trajectoire, le long de la station de découpage, en vue d'un traitement ultérieur ;
caractérisé en ce que
l'outil de découpage comporte au moins une paire d'arêtes de coupe (38a) orientées à un angle compris entre 40° et 60° par rapport à la trajectoire de déplacement de la plaque, et des parties nodale et anti-nodale, dont les arêtes de coupe sont espacées d'une distance définie, égale à la largeur de la bande devant être formée, l'outil étant actionné pour entraî-

ner la vibration de ses arêtes de coupe dans la direction axiale de l'outil, à une fréquence ultrasonore, l'amplitude des vibrations au-dessus de chaque arête de coupe étant pratiquement uniforme, et mis en contact avec la plaque pour former au moins une bande de produit de confiserie à partir de celle-ci.

2. Procédé selon la revendication 1, dans lequel l'outil est soumis à des vibrations ultrasonores à une fréquence d'au moins 10 kHz.

3. Procédé selon la revendication 2, dans lequel l'outil (30) est soumis à des vibrations ultrasonores à une fréquence comprise dans l'intervalle allant de 20 kHz à 40 kHz.

4. Procédé selon l'une quelconque des revendications précédentes, dans lequel l'amplitude des vibrations des arêtes de coupe (38a) de l'outil est comprise dans l'intervalle allant de 10 à 50 microns.

5. Procédé selon la revendication 4, dans lequel l'amplitude des vibrations des arêtes de coupe (38a) de l'outil est comprise dans l'intervalle allant de 28 à 35 microns.

6. Procédé selon l'une quelconque des revendications précédentes, dans lequel l'outil de découpage (30) englobe au moins trois arêtes de coupe (38a), formant au moins une paire de bandes adjacentes (88a) de produit de confiserie, le procédé englobant l'étape d'accroissement de l'espacement dimensionnel entre ces bandes adjacentes (88a), immédiatement après leur formation.

7. Procédé selon l'une quelconque des revendications précédentes, dans lequel l'outil de découpage (30) englobe une corne (77, 81), comportant des lames d'une seule pièce (79, 83) avec des arêtes de coupe qui y sont formées.

8. Procédé selon la revendication 7, dans lequel les arêtes de coupe des lames (76) sont agencées au niveau de ladite partie anti-nodale de l'outil.

9. Procédé selon l'une quelconque des revendications 1 à 6, dans lequel l'outil de découpage englobe une corne (70, 73), comportant des lames formées séparément (72, 76), fixées sur la corne, avec des arêtes de coupe qui y sont formées.

10. Procédé selon la revendication 9, dans lequel les lames (72, 76) sont non résonantes et vibrent en réponse aux vibrations ultrasonores de la corne (70, 73) lorsque l'outil est actionné.

11. Appareil pour découper une plaque (88) de matériau de confiserie, comprenant une station de découpage (30) ; et un transporteur d'entrée (42, 43) pour amener une plaque de matériau de confiserie vers la station de découpage,
caractérisé en ce que
la station de découpage comporte un outil de découpage comprenant une pile à ultrasons, englobant un convertisseur d'énergie (34a) pour changer l'énergie électrique en vibrations ultrasonores, un suramplificateur (35a) pour accroître l'amplitude desdites vibrations, et un cornet à ultrasons (70, 73, 77, 81), comportant au moins une paire d'arêtes de coupe parallèles (38a) espacées d'une distance définie, égale à la largeur d'une bande (88a) devant être formée, les arêtes de coupe étant orientées à un angle compris entre 40° et 60° par rapport à la trajectoire de déplacement de la plaque (88), et positionnées de sorte à contacter une plaque (88) de matériau de confiserie lors de son passage à travers la station de découpage (30), la pile à ultrasons étant orientée de sorte à faire vibrer les arêtes de coupe dans la direction axiale de l'outil de découpage.

12. Appareil selon la revendication 11, dans lequel le cornet (77, 81) et au moins une paire des arêtes de coupe parallèles sont formées d'une seule pièce.

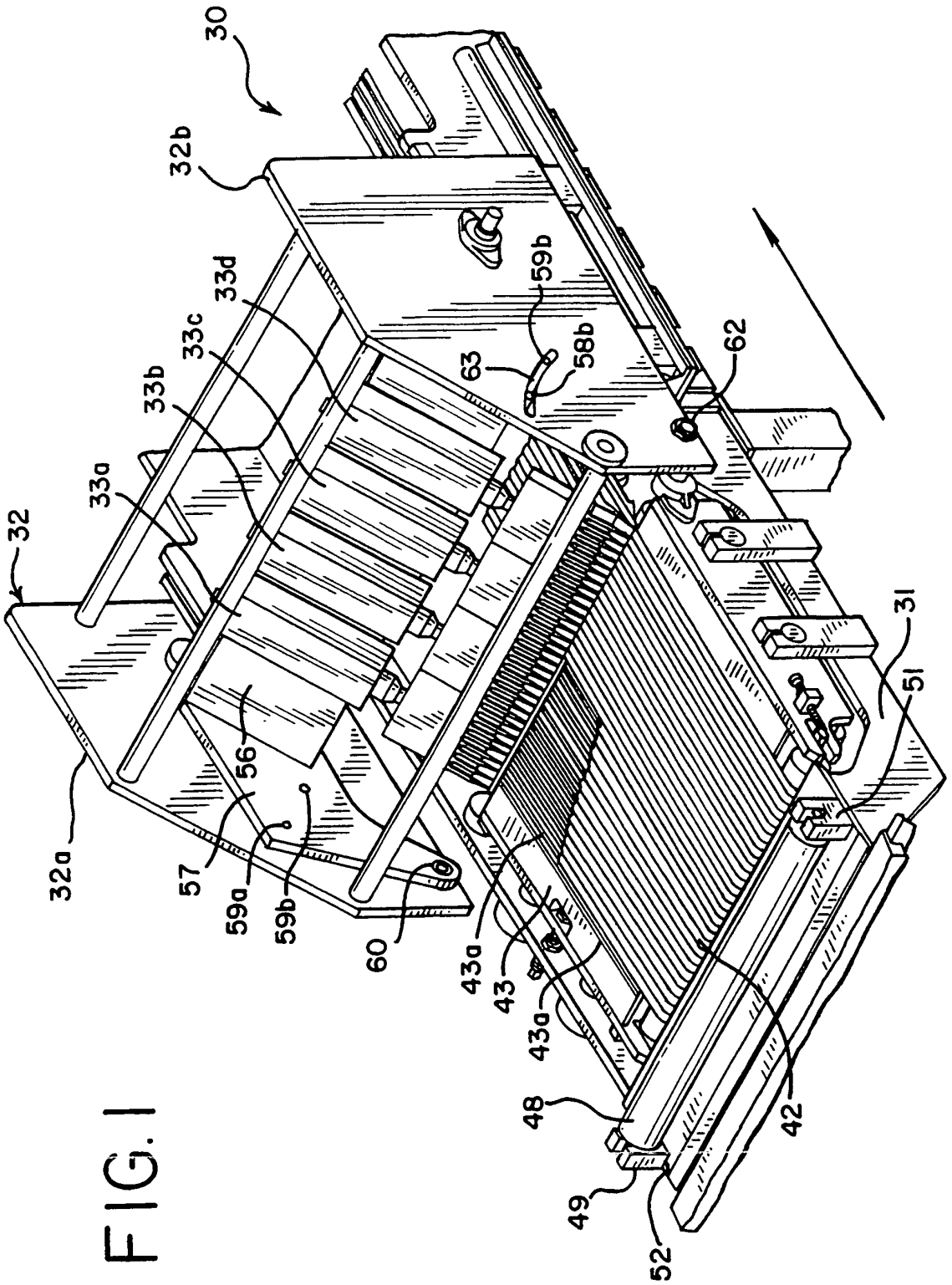
13. Appareil selon la revendication 11, dans lequel au moins une paire d'arêtes de coupe est formée sur des lames séparées fixées sur le cornet (70, 73).

14. Appareil selon l'une quelconque des revendications 11 à 13, dans lequel le transporteur d'entrée comprend plusieurs bandes de transport séparées (42), espacées d'une distance suffisante pour permettre la réception des arêtes de coupe (38a) entre elles.

15. Appareil selon l'une quelconque des revendications 11 à 14, dans lequel l'outil de découpage (33) englobe au moins trois arêtes de coupe espacées et positionnées de sorte à former au moins une paire de bandes adjacentes (88a) de matériau de confiserie, l'appareil englobant un moyen pour accroître l'espacement dimensionnel entre des bandes adjacentes (88a), immédiatement après leur formation.

16. Appareil selon l'une quelconque des revendications 11 à 15, dans lequel plusieurs arêtes de coupe (38a) sont incluses dans chacune de plusieurs piles à ultrasons accouplées (33).

17. Appareil selon la revendication 16, dans lequel chaque arête de coupe (38a) est formée sur une lame de découpage orientée à un angle de 45° par rapport au plan du transporteur d'entrée (42, 43).


30
32b
33d
33c
33b
33a
32
32a
56
57
59a
59b
60
59b
58b
63
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43a
43
43a
48
49
52
42
31
51

FIG. 1

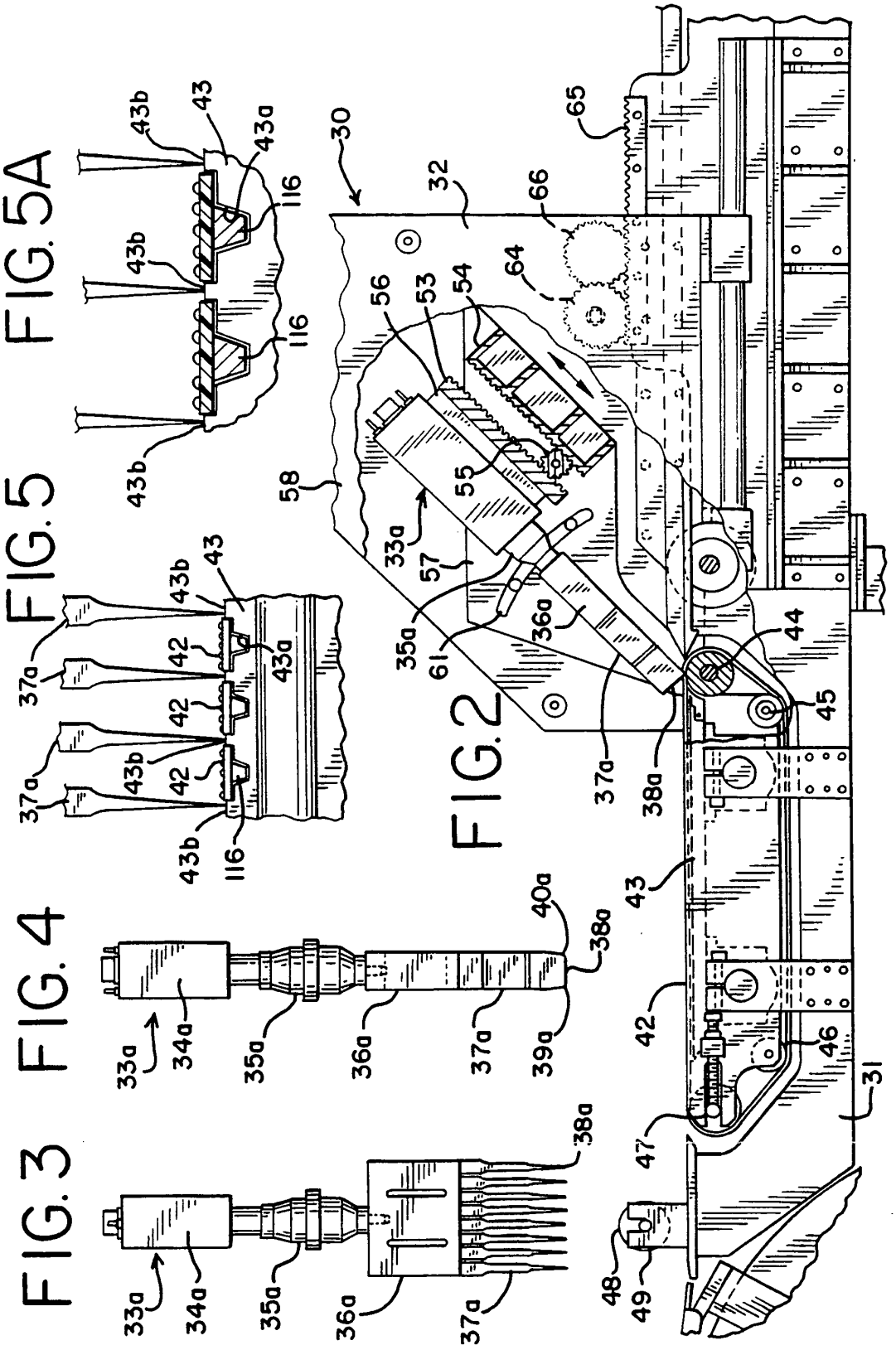
FIG. 5A
FIG. 5
FIG. 4
FIG. 3
FIG. 2
30
31
32
33a
34a
35a
36a
37a
38a
39a
40a
42
43
43a
43b
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66
116

FIG. 12

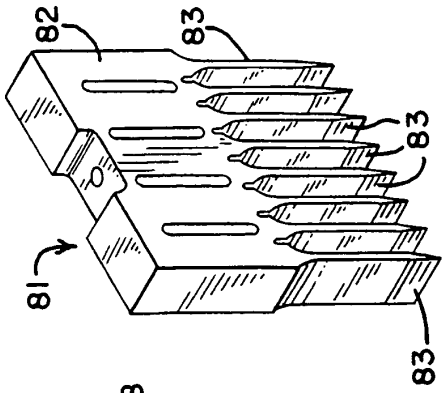


FIG. 13

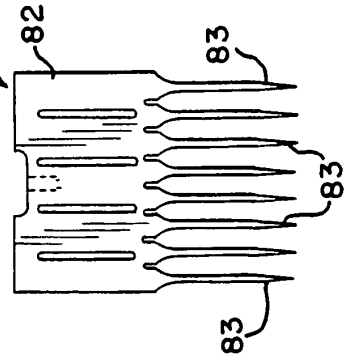


FIG. 10

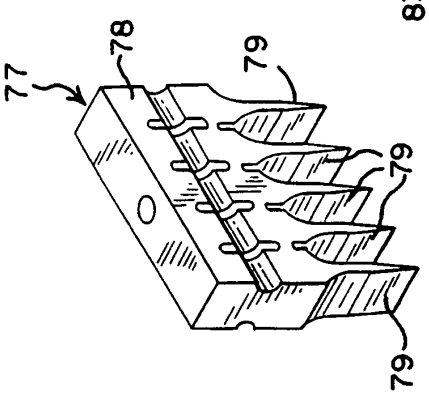


FIG. 11

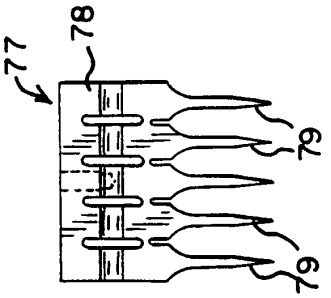


FIG. 8

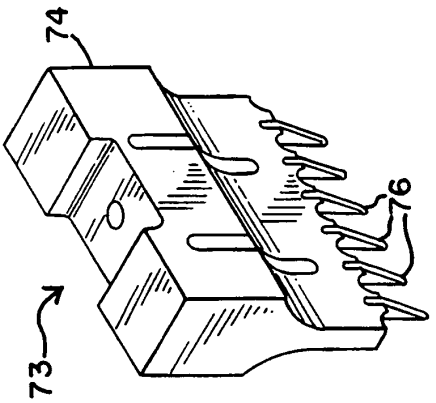


FIG. 9

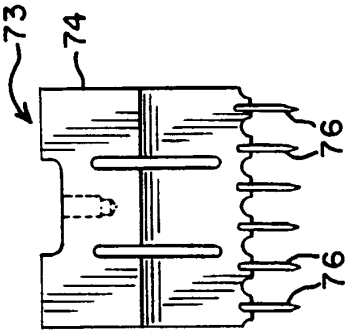


FIG. 6

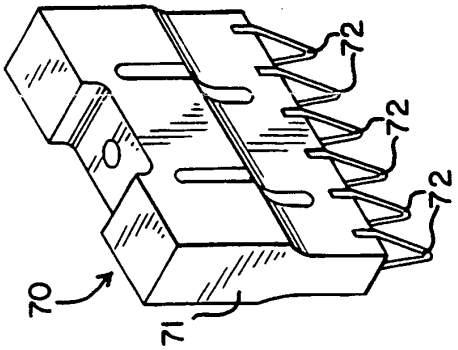


FIG. 7

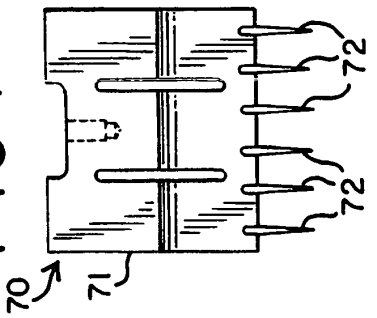


FIG. 14

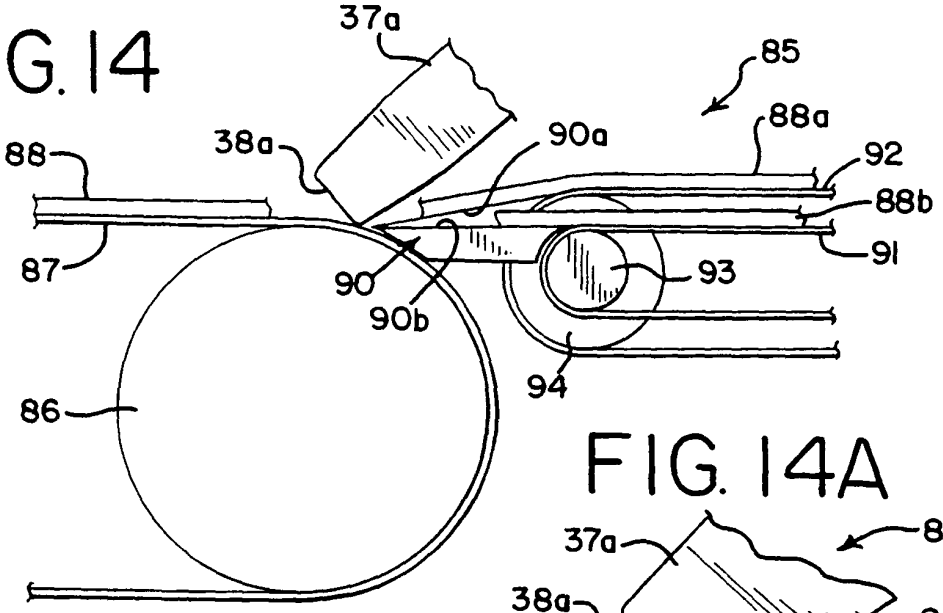


FIG. 14A

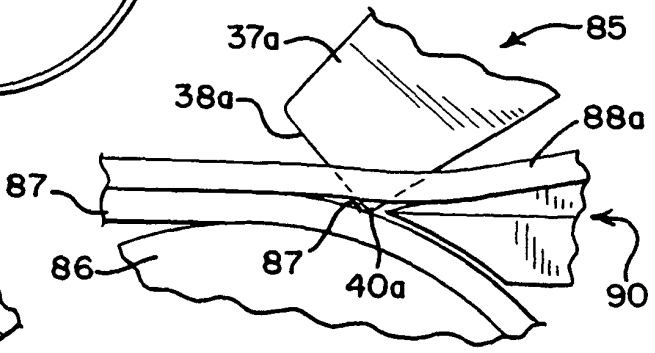


FIG. 15

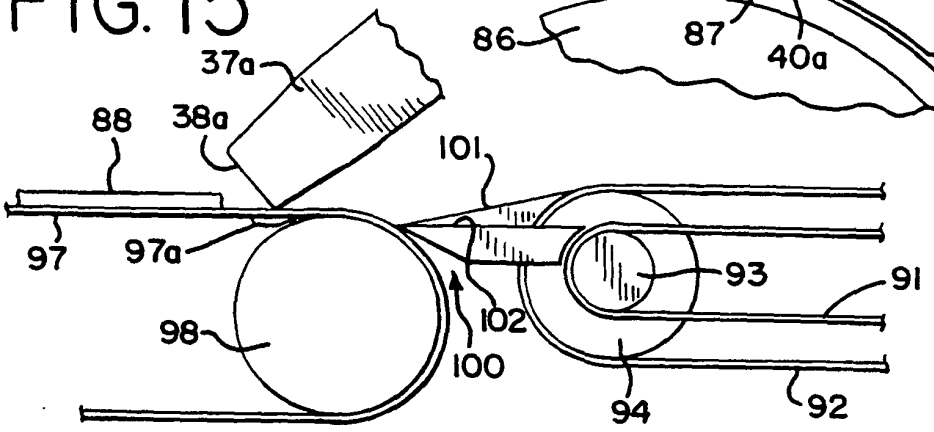


FIG. 16

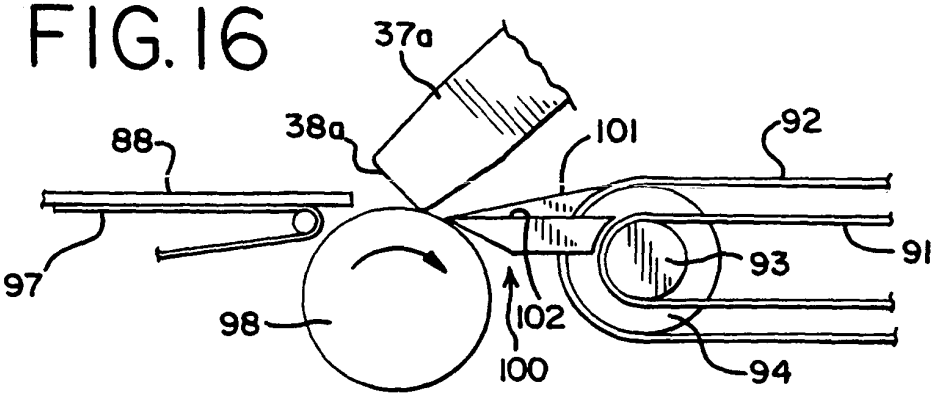


FIG.17

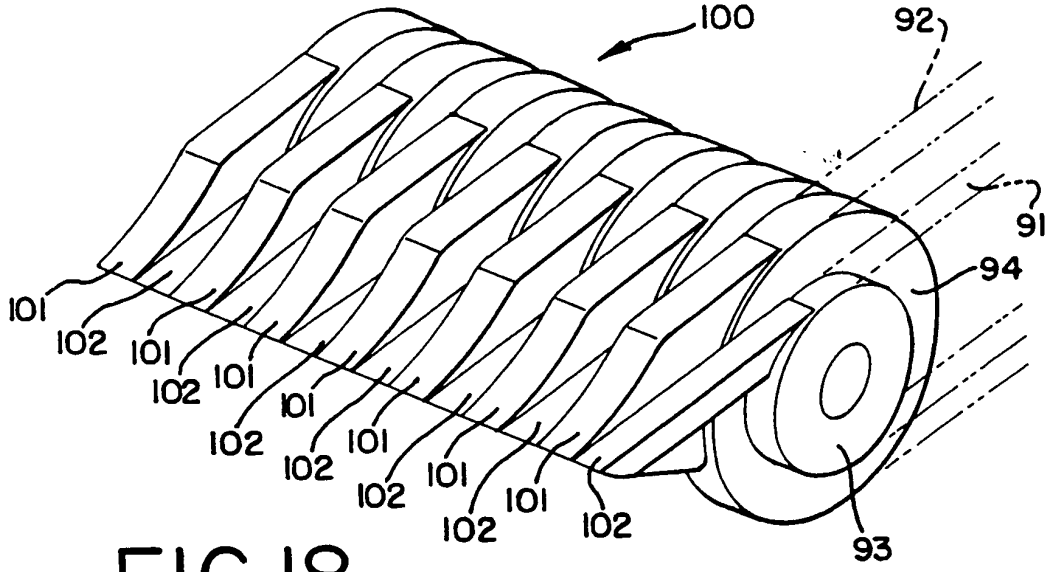


FIG.18

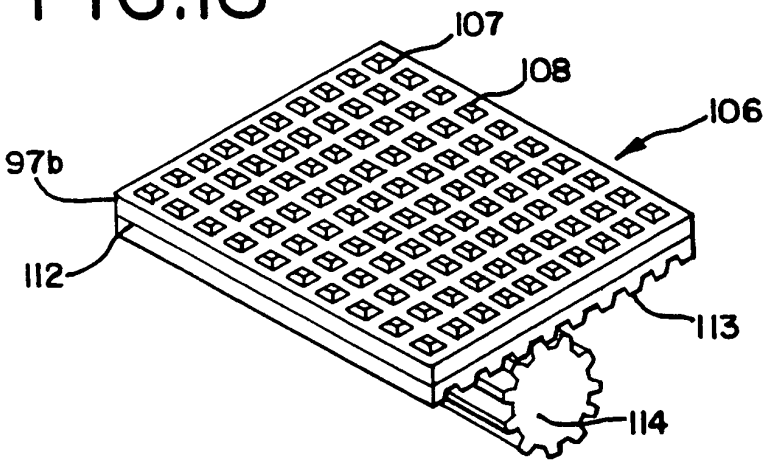
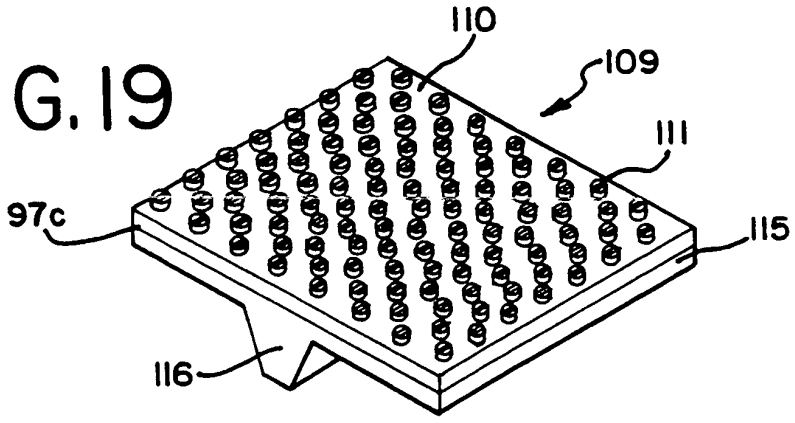


FIG.19



REFERENCES CITED IN THE DESCRIPTION

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